Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 70

NORTHERN LIGHT LAKE AREA

(NTS 52B/SE)

Districts of Rainy River and Thunder Bay

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D.G. Mollard and J.D. Mollard

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FIGURE

1 - Map of the Quetico-Nipigon area showing moraines and orientation of glacial features. 9

MAP
(accompanying report)

Map 5076 (coloured) - Northern Ontario Engineering Geology Terrain Study, Data Base Map, Northern Light Lake (NTS 52B/SE). Scale 1:100 000.

Northern Ontario

Engineering Geology Terrain Study 70

NORTHERN LIGHT LAKE AREA

(NTS 52B/SE)

Districts of Rainy River and Thunder Bay

by

D.G. Mollard[1] and J.D. Mollard[2]

1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Northern Light Lake map-area, Districts of Rainy River and Thunder Bay. The area, which covers NTS block 52B/SE, lies between Latitudes 48°03′N and 48°30′N and Longitudes 90°00′W and 91°00′W. The report forms part of a series of publications that provide similar terrain data for some 370 000 km^2 of northern Ontario.

The purpose of the inventory is to assist regional engineering and resource planning studies at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5076, accompanying this report).

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Interpretation of black and white aerial photographs, at a scale of approximately 1:50 000, formed the basis of the terrain mapping process. The interpretation was checked against published and unpublished maps and reports which documented previous field visits and observations. During the fall of 1978, roads in the map-area were traversed and observed terrain conditions recorded as further verification ot the office studies. Thus, the Data Base Map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further discussion on the mapping techniques, legend format, and possible uses of this engineering geology information is available in the Ontario Engineering Geology Terrain Study Users' Manual (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

2.0 PHYSIOGRAPHY AND GEOLOGICAL SETTING:

Mesas and plateaus up to 150 m high occur in the southeastern part of the Northern Light Lake map-area. These bold physical features, which are particularly well developed around Arrow Lake and Whitefish Lake in the southeastern part of the area, are capped by gently sloping tabular sheets of dark coloured (mafic) intrusive rock of Proterozoic age. Cliffs along their northwestern flanks rise more than 120 m above the surrounding terrain. A thin and generally sparse cover of glacial deposits mantles these large elevated features. Lower ground is underlain mainly by sedimentary and minor volcanic rocks, also of Proterozoic age. The cover of glacial deposits over the bedrock in the lower areas is usually much thicker and more extensive than on the mesas and plateaus.

Felsic igneous and metamorphic rocks commonly underlie glacial materials in the central part of the map-area. The glacial overburden is generally thicker on lower hill slopes and in depressions. It is thinner on ridge tops and upper ridge slopes. Abandoned meltwater channels traverse the northeastern part of the area. Many of them are former glacial lake spillways which follow long, linear depressions between prominent bedrock ridges.

3.0 ENGINEERING TERRAIN UNITS:

The engineering terrain units mapped are identified in terms of four components: surface material, landform, topography, and drainage. Format of the legend used in the terrain mapping is described in detail in the Users' Manual (Gartner, Mollard, and Roed 1980). Landform is a very important component because surface and near-surface materials, topographic expression, and surface and internal drainage conditions, are all related to it. Consequently, the engineering terrain units are grouped, for descriptive purposes, according to the dominant landform.

A particular landform can occur as the only component in a simple terrain unit, or as a dominant or subordinate component in a complex terrain unit. The dominant landform usually occupies more than half of a complex terrain unit. Where only one subordinate landform is shown, it usually occupies between 10 and 50 percent of the complex unit. Where two subordinate landforms are shown, the first covers the larger area. Landforms that occupy less than 10 percent of the terrain in complex unit are rarely indicated in the terrain unit letter code. Where two or three landforms in a complex terrain unit consist of the same material, the landform letter symbols are connected by a dash. Examples of terrain unit letter codes which may occur in this map-area, and an explanation of each, are given in the Appendix.

A large number of complex terrain units has been mapped due to the widespread occurrence of irregular topography. Bedrock, which is situated at or near the ground surface throughout much of the map-area, controls the topography and therefore the surface drainage conditions. Resource development and engineering planning considerations are complicated by these complex conditions.

Noteworthy occurrences of important landforms are described with respect to location, typical materials, topography, and drainage; their significance in geotechnical investigations, regional engineering planning, and resource development is summarized.

3.1 BEDROCK PLATEAU (RL):

3.1.1 Description:

Areas mapped as bedrock plateau (RL) contain bold mesa-like features that have a capping of resistant rock consisting of eroded remnants of Proterozoic diabase sheets. The surface aspect of mesas and plateaus varies from nearly level to moderately sloping. Cliffs around part or all of these elevated features are strewn with coarse talus debris.

The surface of these landforms tends to be dry. Exceptions are the bottoms of long linear depressions. Usually these narrow trenches are partly filled with standing water or they contain organic deposits. Although bedrock plateau areas generally exhibit elevated planar slopes, they may still have knobby and jagged surfaces locally; these features can markedly affect engineering and construction costs.

The surfaces of many high plateau landforms slope gently to the southwest; their northwestern sides often form cliffs up to 120 m in height. The map user should note that these landforms can occur as simple or complex terrain units (e.g. RL(MG/R)).

3.1.2 Occurrence:

Good examples of bedrock plateau landforms are found in the southeastern part of the map-area, around Whitefish Lake, Arrow Lake, and North Lake. Small plateaus northeast and southeast of Head Lake are surrounded by slopewash (CW) and talus (CT). Steep-walled valleys, indicated by the graphic symbol +++ , cross bedrock plateau terrain north of Moose Lake in Robbins Township.

3.1.3 Engineering and Planning Significance:

Construction costs are generally high because slopes are steep and the presence of bedrock often necessitates blasting. Because bedrock plateau areas are aesthetically very pleasing, the possibility of developing small acreages, ski slopes, and sight-seeing tours holds considerable promise in some localities. Cliffs may be unstable since they are subject to rock falls.

Road construction can be extremely difficult and costly in areas where the bedrock is highly uneven and is situated at or very near the surface. On roadways, horizontal and vertical sight distances are generally low and can create a traffic hazard.

3.2 BEDROCK KNOB (RN):

3.2.1 Description:

Bedrock knob landscape (RN) is characterized by an irregular bedrock surface having complex multiple slopes of varying steepness. The cover of glacial deposits overlying the bedrock knobs is generally thin and discontinuous. Much of the glacial overburden consists of bouldery, sand-rich till that was transported only a short distance by the ice.

3.2.2 Occurrence:

Bedrock knob (RN) terrain dominates the entire Northern Light Lake map-area except for the northwestern and southeastern parts. The landscape in this unit contrasts sharply with that of the bedrock plateau (RL) areas. The reason for this is the unique structure in the latter unit, whereby erosional remnants of a resistant rock led to the formation of mesas. The more homogeneous lithology and structure in the rock knob terrain results in less abrupt topography.

Bedrock knobs are usually high and may be knobby, ridged, irregular, or jagged. The bedrock consists mainly of felsic igneous and metamorphic rocks. The summits of higher rock knobs reach 580 m in elevation. The unit contains numerous glacial meltwater channels. Typical examples of rock knob terrain are found near Melvin Lake and Greer Lake in the southern part of the map-area. In these localities, the relief is high, knobby, and jagged, and the maximum elevation is approximately 610 m. Organic terrain occupies many flat areas between the bedrock knobs. A major escarpment extends northeast from Shekaka Lake. Most of the road from Canthook Lake to the resort on the eastern shore of Northern Light Lake traverses rock knob terrain.

3.2.3 Engineering and Planning Significance:

Two principal engineering considerations are the large volumes of rock that must be excavated during construction and the generally uniform and solid foundation conditions at shallow depths. However, due to difficult topography and the existence of rock fractures, bedrock knob terrain is considered poor for most types of light construction and for waste disposal. Drilling and blasting are required during the construction of almost all types of engineering works.

3.3 BEDROCK PLAIN (RP):

3.3.1 Description:

The bedrock plain unit (RP) has a low-lying, undulating to rolling surface. The bedrock is generally mantled by a thin and variable cover of glacial material, consisting mainly of boulder-rich, sandy till. The rock plains display considerable local variation. They may consist of bare bedrock or may be covered by till or fine-grained water-laid deposits.

3.3.2 Occurrence:

Bedrock plains occur along the northern shore of Arrow Lake in the southern part of the map-area and in several places north of Whitefish Lake in the eastern part.

3.3.3 Engineering and Planning Significance:

Engineering and construction problems relate mainly to the cost of bedrock excavation. Foundation materials are strong, have a low compressibility, and a permeability that is controlled almost entirely by rock fractures. Bedrock plains are poor construction and waste disposal sites, but are still considered better than areas mapped as bedrock plateau (RL), bedrock knob (RN), or bedrock ridge (RR). Drainage courses tend to follow eroded zones of weakness in the underlying bedrock. Many of these depressions occupy preglacial channels that were enlarged by glacial erosion. A large proportion of the ground water in this landform is confined

to fractures in the upper 45 to 60 m of bedrock. Permeability varies from impervious to highly pervious, depending on the spacing, depth, and width of fissures in the bedrock. Rock materials have high compressive, shearing, and bearing strengths. Position of the water table varies with topography, being closer to the surface beneath depressions. By careful route selection and proper design of vertical alignment, rock cuts on lower class roads can be avoided or at least the volume of rock to be blasted can be minimized. This is possible because of the low relief surfaces associated with many of the bedrock plains.

3.4 BEDROCK RIDGE (RR):

3.4.1 Description:

The bedrock ridge unit (RR) consists of long, narrow, subparallel and intersecting bedrock ridges of varying height. Thickness of drift over the masked bedrock surface varies substantially over short distances. In general, it is relatively thin (1 to 2 m) on ridge tops and thicker on the lower slopes and in the depressions between rock ridges.

3.4.2 Occurrence:

Terrain dominated by bedrock ridges and escarpments occurs north of North Fowl Lake in the southeast corner of the map-area. Here the Proterozoic rocks form high, elongate ridges rather than plateau and mesa landforms. A large expanse of Archean greenstones, pyroclastics, slates, and greywackes is located north of Saganaga Lake on the western margin of the area. These rock types locally form intermingled ridge and knob terrain, which has been mapped as RR(RN). The relief in this area is similar to that occurring on granitic terrain near Trafalgar Bay on Northern Light Lake. This mixed unit (either RR(RN) or RN(RR)) also occurs on both sides of the Wawiag River valley in the northwest corner of the area, where greenstone and pyroclastic rocks are found at or near ground surface (Tanton 1938).

3.4.3 Engineering and Planning Significance:

The main construction problem is the large quantities of very hard rock that often must be excavated during construction. Drilling and blasting costs can be very high. Bedrock ridge terrain is considered poor for most types of engineering, construction, and resource development. It also has a low rating for waste disposal due to irregular relief, the presence of rock fractures near the ground surface, and the high cost of earthwork construction.

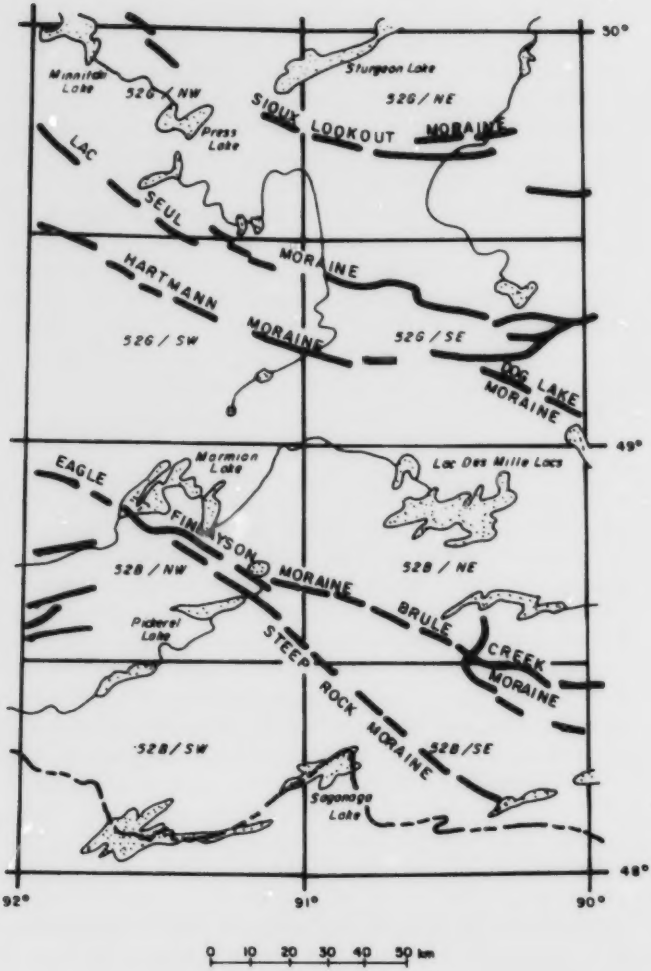
3.5 END MORAINE (ME):

3.5.1 Description:

End moraine (ME), which forms either prominent or inconspicuous till ridges, was deposited along the margin of the glacier. Although the ridges are usually long and narrow, they can be hummocky in places. End moraine consists largely of ice-deposited till and boulders, with minor inclusions of water-laid silt, sand, and gravel. Segments of end moraine, composed mainly of till, occur with hummocky moraine (MH), kames (GK), and ice-contact deltas (GD) in large moraine complexes which are identified by name in Figure 1. The bedrock surface is nearly always buried in areas of end moraine; there are exceptions, however, and in a few places end moraine ridges have a core of solid rock.

3.5.2 Occurrence:

The locations of major moraine complexes containing segments of end moraine are shown in Figure 1. Where these complexes consist largely of end moraine, but contain a substantial, if subordinate, amount of water-laid sand and gravel (e.g. in kames), the combined letter symbol ME(GK) is used. A good example of this complex type of terrain occurs along the morainal ridge southeast of Trafalgar Bay on Northern Light Lake. Generally low and not particularly prominent, this ridge extends from Trafalgar Bay northwest through Plummes Lake to Greenwood Lake. Similar occurrences are found southwest of Clovenhoof Lake on the northern margin of the map-area and on the south shore of Batwing Lake in the northeast corner of the area. Several sand and gravel pits have been opened in the latter deposit.



NOTE: Moraine segments shown in the figure do not necessarily all occur on the Data Base Map accompanying this report.

FIGURE 1 - MAP SHOWING MAJOR MORAINES IN NTS 52B AND 52G (MODIFIED FROM ZOLTAI 1965, FIGURE 3)

3.5.3 Engineering and Planning Significance:

An important characteristic of end moraines is their variability. Layers of unsorted and unstratified material of varying sizes (i.e. till), can both underlie and overlie sequences of layered silt, sand, and gravel. In general, the boulder content of this landform is high. End moraines in the map-area commonly exhibit variable permeability and internal drainage, low compressibility, and high bearing strength. The water table is low in end moraine ridges. Where the unit consists of till that is high in sand- and gravel-sized material, and where sources of stratified sand and gravel are scarce, the coarse till may sometimes be crushed and used as a source of road-surfacing material. End moraines may present excavation difficulties during the building of roads and structures due to the abundance of small and large boulders.

3.6 GROUND MORAINE (MG):

3.6.1 Description:

The term ground moraine, (MG) refers to an extensive deposit of till forming an undulating to rolling plain. Although till is generally composed of an assortment of particle sizes (including clay, silt, sand, gravel, cobbles, and boulders), till deposits in this map-area have a high sand and boulder content. The thickness of till in ground moraine varies from less than 1 m to many tens of metres. The landform is mapped as MG where the till is thick enough to mask any topographic effect of underlying bedrock. In general, the till layer forms a mantle less than 3 m thick over the bedrock and is mapped as MG/R. Till in ground moraine tends to be thicker in bedrock depressions and thinner over bedrock ridges and knobs.

3.6.2 Occurrence:

There is very little thick till in the ground moraine units which occur in the Northern Light Lake map-area. There are several large areas where the ground moraine till forms a thin, discontinuous mantle over bedrock (MG/R).

Ground moraine occurs along the new road between Nelson Lake and Heart Lake on the northern margin of the map-area. Here the glacier overrode sandy lacustrine sediments and deposited a thin layer of sandy till. West of Nelson Lake, the ground moraine till is discontinuous and the influence of bedrock on relief and surface materials becomes more important. A similar situation (MG/R) occurs around Batwing Lake and Hoof Lake in the northeastern part of the area, where a large amount of exposed bedrock can be seen.

3.6.3 Engineering and Planning Significance:

The till in ground moraine is coarse and bouldery, and has moderate permeability and internal drainage, low compressibility, and high bearing strength. Water table position varies with relief, being lower beneath knolls and low ridges, and higher beneath depressions. The till in many of the depressions is covered by thin deposits of peat and muck.

The suitability of ground moraine for road and other light foundation construction is fair to good. The fact that the till often forms only a thin mantle over the bedrock (MG/R) has a great deal of significance in road building. Road construction through this type of terrain is difficult owing to the bouldery nature of the till and the probability of encountering bedrock in cuts. The suitability of ground moraine for waste disposal varies from poor to fair.

3.7 HUMMOCKY MORAINE (MH):

3.7.1 Description:

Although some hummocky moraine deposits formed along an active ice front, most of the sediments which make up this landform accumulated on the surface of stagnant glacial ice. In time, the buried ice melted and deposited a layer of unsorted till and, in places, washed glacial debris. Most hummocky moraine consists of steep-sided knobs and short ridges separated by undulating to flat plains and swampy kettle hole basins. Soil materials in hummocky moraine include till, usually as the dominant constituent, and subordinate amounts of stratified silt, sand, and gravel in pockets or lenses. Hummocky moraine can be very bouldery. Scattered kames (GK) are a common subordinate landform.

3.7.2 Occurrence:

Hummocky moraine with associated bedrock knobs (MH(RN)) occurs east of Sandstone Lake in the eastern part of the map-area. It also occurs as a subordinate landform in a unit, dominated by kames (GK(MH)), which occupies a broad depression connecting Sandstone Lake and Iron Range Lake in the central part of the area.

3.7.3 Engineering and Planning Significance:

Engineering considerations include the large quantities of material that may have to be excavated during construction, a high content of boulders, and rapid changes in the nature of the materials. Pockets of sand and gravel constitute small sources of construction material of variable quality.

Although variable, most areas of hummocky moraine have moderate permeability and internal drainage, low compressibility, high bearing strength, and low shrink-and-swell potential. In depressions, the till deposits are commonly covered by thin, water-laid silt and clay, which in turn are overlain by peat and muck deposits. Hummocky moraine is considered fair to poor for general construction purposes and for waste disposal.

3.8 ICE-CONTACT DELTA (GD):

3.8.1 Description:

Esker deltas, kame deltas, and delta moraines are all varieties of the ice-contact delta. Some are quite large in area and important in terms of the volume of recoverable sand and gravel which they contain. Individual beds, consisting mainly of sand or gravel, are usually better sorted, cleaner, and less variable than stratified deposits in esker (GE) and kame (GK) landforms. The beds in this unit are also typically less folded and faulted and are more continuous. It is worth noting that materials in many ice-contact deltas are coarse (i.e. gravelly) on the north and northeast sides and finer (i.e. sandy) on the south and southwest sides. These conditions indicate the parts of the delta which were, respectively, closest to and farthest from the glacial front against which the delta was built.

3.8.2 Occurrence:

Small ice-contact delta deposits, located north of North Fowl Lake in the southeast corner of the map-area, consist of sand and gravel and range in elevation from 455 to 485 m. A large ice-contact delta, situated between Whitefish Lake and Arrow Lake in the southeastern part of the area, ranges in elevation from 485 to 500 m. It represents a good source of sand and gravel for a variety of construction uses. Other delta deposits occur astride the Robbins-Hardwick township boundary and around the east end of Arrow Lake. In the latter area, the present shoreline has formed in the distal part of a large, sandy ice-contact delta. Several pits have been excavated in this deposit.

A thin sand and gravel deposit overlies bedrock along the north shore of Arrow Lake. A small delta is shown east of Granite Lake in the south-western part of the map-area. Picnic and camping areas on the east shore of Northern Light Lake (Southeast Bay) are located on a kettled ice-contact delta. Two deltaic deposits occur on the shores of Titmarsh Lake.

3.8.3 Engineering and Planning Significance:

Ice-contact deltas are good potential sources of concrete and blacktop aggregate. They are also favorable sites for the construction of airstrips, roads, and other types of engineering works. Because the subsoils are highly permeable, deltaic (GD) landforms are relatively poor areas for waste disposal. Larger deposits, however, are generally good ground water prospects, especially where sand gravel horizons are thick and extend below the water table. Ice-contact deltas possess high bearing strength and good workability in wet weather. Slopes are stable and subsoils are well drained. Away from the steeply sloping margins of this landform, earthwork volumes and excavation costs are normally low. Reservoirs and sewage lagoons in ice-contact deltas must be lined to prevent excessive leakage.

3.9 ESKER (GE):

3.9.1 Description:

The ridged landform represented by the esker symbol (GE, >>>) also includes crevasse fillings. Both occur as long, narrow, sand and gravel

ridges that can be winding or straight and may widen in places. Some of these elongate ice-contact stratified drift ridges include braided, branching, beaded, and kettled segments. Most of the ridges trend roughly parallel to the last direction of glacial flow. The cores of many eskers and crevasse fillings contain complexly layered units, consisting of sandy gravel and gravelly sand, that exhibit collapse structures (*i.e.* folds, faults, and pinch-outs of strata). Some silt and fine sand units (water-laid), boulders, and till pockets may occur within the central parts of eskers and crevasse fillings, as well as along their flanks.

3.9.2 Occurrence:

Eskers and crevasse fillings are comparatively rare features in the Northern Light Lake map-area. One noteworthy exception is the 3 to 4 km long esker ridge located east of Weikwabinonaw Lake in the central part of the area.

3.9.3 Engineering and Planning Significance:

Eskers and crevasse fillings are relatively small and isolated landforms in this map-area, and are generally inferior to ice-contact delta and glacial outwash deposits as sources of good quality granular construction materials. Typically, the unit possesses high permeability and good internal drainage, low compressibility, high bearing strength, low frost susceptibility, and low shrink-and-swell potential. Where esker ridges are steep-sided, narrow, and winding, they may be unsuitable for use as transportation routes. They may trend in the wrong direction for route location purposes, but in regions that are dominated by large expanses of swamp and bedrock, eskers are frequently considered as good route location possibilities. Where the sand and gravel in large eskers extends many metres below the water table, the unit represents a potential source of ground water for domestic and, possibly, municipal and industrial use.

3.10 KAME (GK):

3.10.1 Description:

Kames occur either as steep-sided single knobs or as clusters of several

knobs in kame fields and kame moraine. The larger, steep-sided kames usually have an irregular surface; in a few places, they contain deep kettle hole depressions. Most are composed of complexly interbedded sand and gravel strata which regularly exhibit fold, fault, and pinch-out structures. Kames also contain variable but usually minor amounts of silt, till, and boulders. Large kame deltas are discussed in Section 3.8; kame terraces are rare.

3.10.2 Occurrence:

Several kame deposits occur southeast of Arrow Lake in the southeastern part of the map-area. A complex terrain unit, consisting predominantly of kames and mapped as GK(MH)(RN), extends from Sandstone Lake west to Sunbeam Lake in the central part of the area. One of the kame ridges rises to an elevation of 535 m. This unit is probably part of the Steep Rock Moraine (Figure 1). A small kame unit lies south of Roundtable Lake in the eastern part of the map-area. A potentially coarse granular deposit, mapped as gsGK, occurs along the road west of Nelson Lake near the northern margin of the area. Part of the Steep Rock Moraine, mapped as GK(ME), extends from Big Ghee Lake to Greenwood Lake in the northwestern part of the map-area. A unit consisting of kames with subordinate amounts of end moraine (ME) extends from the eastern end of Batwing Lake northwest towards Star Lake, in the northeastern part of the area; this may be part of the Eagle-Finlayson Moraine (Figure 1).

3.10.3 Engineering and Planning Significance:

In general, kames have high permeability and good internal drainage, low compressibility, high shear strength, and good bearing capacity. Position of the water table varies with relief, being nearer the surface beneath kettle depressions and deeper beneath ridges and knobs. Although the granular materials in kames provide good foundations for buildings and small engineering works, the quantities of material that must be excavated during construction can be moderately high. Waste disposal sites require special design procedures and costly construction in order to function properly. Kames should be avoided as waste disposal sites. They vary from poor to good as sources of sand and gravel aggregate, depending upon their size and compositional variability.

3.11 OUTWASH PLAIN (GO):

3.11.1 Description:

Outwash deposits include plains, fans, deltas, and valley trains of varying sizes, all consisting mainly of sand and gravel. Most outwash sediments were drained from the front of a melting glacier and accumulated in flooded lowlands and valley bottoms. Although most outwash deposits formed in proglacial positions, some accumulated over masses of stagnant glacier ice, resulting in pitted or kettled surfaces. Outwash landscapes that show abandoned channel scars, braid bars, or deep kettle holes are commonly coarse in texture (i.e. gravelly and cobbly rather than sandy).

3.11.2 Occurrence:

Outwash landforms have been identified in the area southwest of Prelate Lake and in a prominent meltwater channel that connects Whitefish Lake and Arrow Lake. Outwash sand and gravel deposits surround bedrock knobs northeast of Gneiss Lake in the southwestern part of the map-area. Similar deposits are found northwest of Titmarsh Lake in the central part. Outwash deposits are common north, west, and east of Marks Lake in the northeastern part of the area. Several pits have been excavated along the road east of Marks Lake for the removal of coarse granular material (gsGO). Outwash deposits have been mapped north and south of the end moraine near Swallow Lake and Hoof Lake on the northern margin of the area. Dunes have formed on the sandy outwash between Aldina Township and the Matawin River near the eastern margin.

3.11.3 Engineering and Planning Significance:

Outwash landforms almost always have high permeability and good internal drainage, low to very low compressibility, low shrink-and-swell tendencies, and high shear strength and bearing capacity, particularly where these granular deposits are confined. Granular materials in outwash landforms form stable slopes and are seldom susceptible to frost heave. Being level and well drained, the sediments in outwash plains are not easily eroded by running water. The boulder content is generally low. A high water table can be expected beneath kettle depressions. Extensive outwash

plains provide excellent sites for the construction of roads and airstrips, and are often good sources of concrete and bituminous aggregate. They are good potential sites for ground water development, particularly where the granular deposits are deep and are recharged by water from nearby lakes and rivers.

3.12 GLACIOLACUSTRINE PLAIN (LP):

3.12.1 Description:

Sediments in glaciolacustrine plains consist of varved and massive, fine-grained materials deposited in glacial lake basins of varying size and depth. The proportions of clay, silt, and sand deposited at any particular location in these basins varies with depth of water in the former lake, distance from former shorelines, and the size of particles washed into the lake. Most clay, silt, and sand lacustrine deposits contain minor inclusions of till and scattered dropstones which were rafted into the lake on pieces of ice. In places, wave and current action in former glacial lakes eroded the surface of till deposits, producing thin patches of washed sand, gravel, and boulders that rest on till or bedrock. In other areas, bedrock knobs and ridges are surrounded by pockets of glaciolacustrine sediment. Glacial lake deposits usually consist of clay and silt (cLP, cmLP, mcLP) which accumulated in deep offshore waters at a depth where the bottom was no longer affected by wave action. Closer to shore, and at points where rivers discharged sandy materials into the lake, the deposits usually consist of fine and medium sand with minor silt (sLP, smLP). Most of these sandy lacustrine deposits accumulated in deltaic environments.

3.12.2 Occurrence:

Glaciolacustrine deposits occur beneath the Arrow River basin in the southeast corner of the map-area. The surface of these sediments is generally less than 395 m in elevation, and they are covered by extensive deposits of organic material (peat and muck). The organic deposits overlying the lacustrine clay, silt, and very fine sand become thinner north of the Arrow River in Hartington Township. Glaciolacustrine clay plains occur north of Whitefish Lake on the eastern margin of the area and in the

valley of the Matawin River in the northeast corner. Glaciolacustrine deposits also occur sporadically in low-lying areas throughout the western half of the map-area.

3.12.3 Engineering and Planning Significance:

Glaciolacustrine clay deposits (cLP) have high water retention capacity, low permeability, and poor internal drainage, most of which is controlled by a network of closely spaced joints. Characteristically, these landforms possess low density, low bearing strength, and moderate to high compressibility, unless the fine-grained sediments have been consolidated by the weight of overriding glacier ice or by desiccation. The clay sediments usually provide poor foundation conditions and can be difficult to work with heavy construction equipment during wet weather. Most clay plains in the map-area are level to gently sloping. The sides of river valleys which have been deeply incised into these fine deposits are usually highly dissected and are susceptible to rill-and-gully erosion on freshly cut ditch and highway back slopes. Higher and steeper natural and man-made slopes are subject to small failures. Where these lacustrine materials carry a high proportion of silt or very fine sand, they are susceptible to frost heave and the formation of frost boils. Subsoil permeability ranges from low to nearly impervious; as noted above, this is largely dependent on the presence of a system of closely spaced joints. In locations where glaciolacustrine clay sediments are highly plastic, they have a tendency to shrink or swell with changes in moisture content. Bearing capacity, shear strength, and compressibility vary greatly with differences in previous loading history and, therefore, the natural moisture content. Bearing capacities can be low in wet areas, particularly where plastic clay soils are normally consolidated or only slightly consolidated.

Low-lying clay plains have a high water table and are subject to local flooding during spring runoff and heavy cloudbursts. During wet weather, the glaciolacustrine clay sediments have poor workability characteristics for building roads and structures. This landform usually provides good sites for waste disposal because of its low permeability.

Lacustrine sand plains (sLP) contain mostly fine and medium sand with minor silt. Coarse sand, gravel, cobbles, boulders, and till are rare in these deposits. Sand plains are gently sloping to undulating and are well drained.

A high water table may occur at sites located some distance from the ground water lowering effects of deep valleys and ravines. Sandy lacustrine materials are typically nonplastic and have high permeability, low compressibility, moderate to high bearing capacity, and high shear strength. They are generally not frost susceptible unless they contain a significant amount of silt and very fine sand. They represent fair to good terrain for most construction, especially that of roads and airstrips. They are poor for waste disposal due to the possibility of effluent seepage and ground water contamination.

3.13 ALLUVIAL PLAIN (AP):

3.13.1 Description:

Many alluvial deposits (AP) in this map-area consist of fine and medium sand at depth; these materials are commonly overlain by a silty upper stratum of variable thickness. Oxbows and abandoned channel segments occur where meandering streams cross landforms composed largely of loose silt and fine sand. Sediments beneath alluvial plains are finer textured where the material being carried by the stream was eroded from clay and silty clay glaciolacustrine deposits. The landform includes flood plains that have been eroded in till and are strewn with boulders, as well as segments of stream valleys where alluvial sediments range in texture from coarse sand to coarse gravel and cobbles. Long and complex alluvial plain systems sometimes include three constituent landforms: low alluvial terraces, alluvial flood plains, and stream channels.

3.13.2 Occurrence:

Alluvial plains occur (1) along the Arrow River in the southeast corner of the map-area; (2) along the Weikwabinonaw River in the central part of the area, where the river occupies a former spillway channel; (3) in meltwater channels around the Wawiag River in the northwest corner of the area; and (4) along the Matawin River in the northeast corner.

In places, the alluvial deposits are covered by varying thicknesses or organic material. Alluvial sediments occur beneath a blanket of organic deposits

(1) west of Mowe Lake in the western part of the map-area; (2) northeast of Flatrock Lake in the east-central part; and (3) along the Matawin River in the northeastern part.

3.13.3 Engineering and Planning Significance:

Alluvial plains are subject to flooding. The water table is usually situated at or near the surface for much of the year; organic-filled depressions are common. Although some alluvial terraces, flood plains, and channel bottoms represent potential sources of sand and gravel for construction purposes, the high water table may cause problems during excavation of such materials. This landform is generally unsuitable for transportation routes, general construction, or waste disposal sites because of the high water table and risk of flooding.

3.14 TALUS SLOPE (CT):

3.14.1 Description:

Pieces of broken rock that have fallen from cliffs and accumulated in piles along the base of near-vertical rock faces are mapped as talus slopes (CT). Rock falls are a common phenomenon in this hazardous environment. Angular pieces of rock vary from several centimetres to more than a metre in size. The talus debris is usually composed of only one type of rock (*i.e.* the lithology that forms the cliff above the talus slope).

The material which comprises the talus slope has been called rubble and is denoted by the letter r. Downslope from the base of talus piles, scattered pieces of rock have come to rest on sandy to gravelly slopewash deposits. In many places, blocks of talus are enclosed in slopewash material.

3.14.2 Occurrence:

Large talus piles (CT, ▲▲▲) were mapped south of Addie, Prelate, and Iron Range Lakes in the south-central part of the map-area. Intermingled talus and slopewash materials, indicated by the symbol CW(CT), occur in the southeast corner of the area. In some places, the pieces of talus material

are so sparse that they cannot be detected on airphotos and must be inferred. This situation, indicated by the graphic symbol △△△, occurs on the south shores of Arrow, Sandstone, and Whitefish Lakes in the south-eastern part of the area.

3.14.3 Engineering and Planning Significance:

Heavy construction work on loose, angular blocks of talus can be hazardous because of (1) the possibility of intermittent rock falls and (2) the slope instability associated with the removal of blocks that support overlying pieces of talus. Most talus deposits possess an open structure with large voids and are thus highly pervious. The rock in talus piles represents a possible source of crushed aggregate for railway ballast and riprap. Permanent engineering structures should not be constructed on thick piles of talus because of the hazards mentioned above and the possibility of talus creep.

3.15 SLOPEWASH SHEET (CW):

3.15.1 Description:

Slopewash sheets are almost always poorly expressed in airphotos. The presence of these sheets must therefore be inferred from depositional environments that are recognizable on the photos. They usually contain poorly sorted, poorly stratified, loosely deposited sediments that have been washed down the surfaces of moderately steep slopes by unconcentrated overland sheet flow or transported down steep slopes by frost action and soil creep processes. Most of these materials were probably transported and deposited in a periglacial climate. Slopewash deposits commonly merge upslope with piles of talus debris and downslope with till and fine-grained lacustrine sediments.

3.15.2 Occurrence:

This terrain unit occurs only in the southern part of the map-area, near Whitefish, Arrow and North Lakes, where near-vertical cliffs composed of jointed, tabular sheets of Proterozoic diabase surround the tops of

mesas and plateaus. The slopewash unit may rest on bedrock (CW/R) below steep escarpments (e.g. north of Moose Lake) or be closely associated with talus (CW(CT)) (e.g. south of Whitefish Lake). Sheets of slopewash material overlie till (CW/MG) along the south shore of Arrow Lake. Similar deposits are found south of Addie, Iron Range, and Sandstone Lakes. A small pit has been excavated in the slopewash unit south of Sandstone Lake.

3.15.3 Engineering and Planning Significance:

Pits in this landform contain poorly sorted, poorly graded, dirty (silty) sand and angular rock particles of varying sizes. The material is usually too dirty to use as concrete or blacktop aggregate without being washed. Nevertheless, where these deposits are sufficiently thick and dry, the material can be crushed to produce a satisfactory road surfacing material. In general, slopewash deposits are thin and loose, and may possess a loose openwork (*i.e.* porous) structure. Subsoils are often wet, even though the slopes may appear steep enough to be well drained. Seepages and springs are common occurrences. Engineering problems caused by slopewash terrain include poor geometrics in road design and relatively high cuts and fills during construction.

3.16 ORGANIC TERRAIN (OT):

3.16.1 Description:

Organic terrain includes varying depths of peat and muck in marshes, swamps, fens, and bogs. No attempt was made to separate these organic landscape types during the mapping. Although peat and muck deposits usually occur as relatively thin surficial layers, in places these organic materials can be several metres thick. Moreover, the thickness of the deposits can change drastically over very short distances.

3.16.2 Occurrence:

Occurrences of organic terrain in the southeast and northeast corners of the map-area are generally thin and overlie glaciolacustrine clay. The

extensive deposits in the northeast-central part of the area and some of the small occurrences in the western part overlie either glaciofluvial outwash deposits or alluvial plains. The numerous occurrences in the central part of the area occupy depressions or stream valleys in bedrock terrain.

3.16.3 Engineering and Planning Significance:

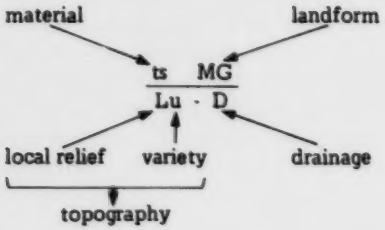
Although organic deposits are commonly thin, they are nonetheless very poor foundation and construction materials. The water table is at or near ground surface for most of the year. The locations of deeper pockets of organic material are difficult to predict reliably without extensive test-drilling. The topography of organic terrain is level or slightly depressional. Peat and muck deposits have low shear and bearing strengths and generally low permeability. They are nearly always poorly drained, highly compressible, and are subject to seasonal flooding. Consequently, they are unsuitable for nearly all types of engineering works and for waste disposal.

4.0 APPENDIX: EXAMPLES OF TERRAIN UNIT LETTER CODES:

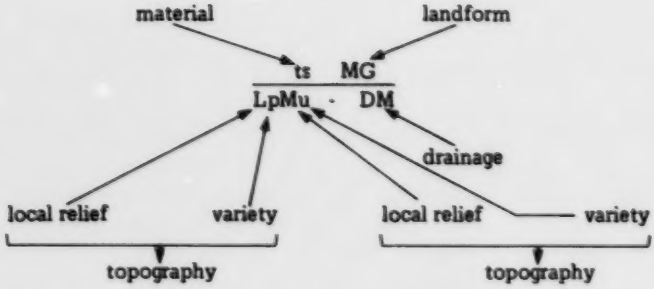
The engineering terrain unit letter codes consist of four components: surface materials, landform, topography, and drainage. The format of the letter codes used in describing the terrain units is discussed in detail in the Users' Manual (Gartner, Mollard, and Roed 1980). Some additional examples of the letter codes are as follows:

4.1 SIMPLE TERRAIN UNIT:

Example 1:



Example 2:

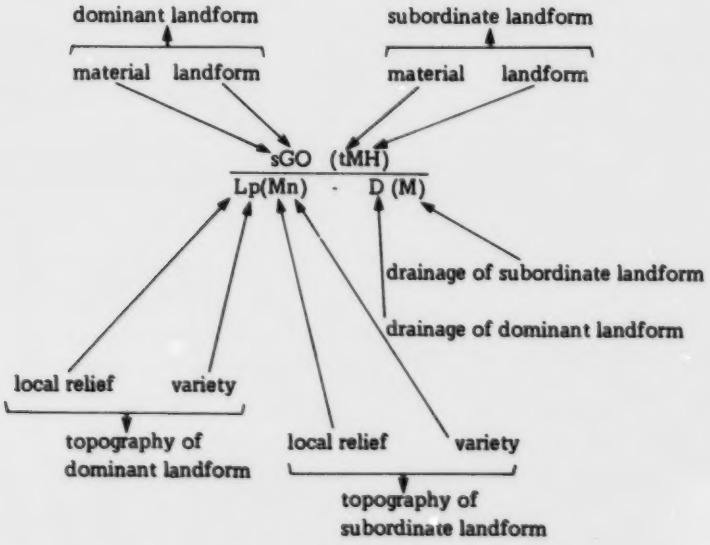


Note: The above type of letter code is used where there are two distinctly different types of topography and/or drainage in a simple terrain unit.

4.2 COMPLEX TERRAIN UNIT:

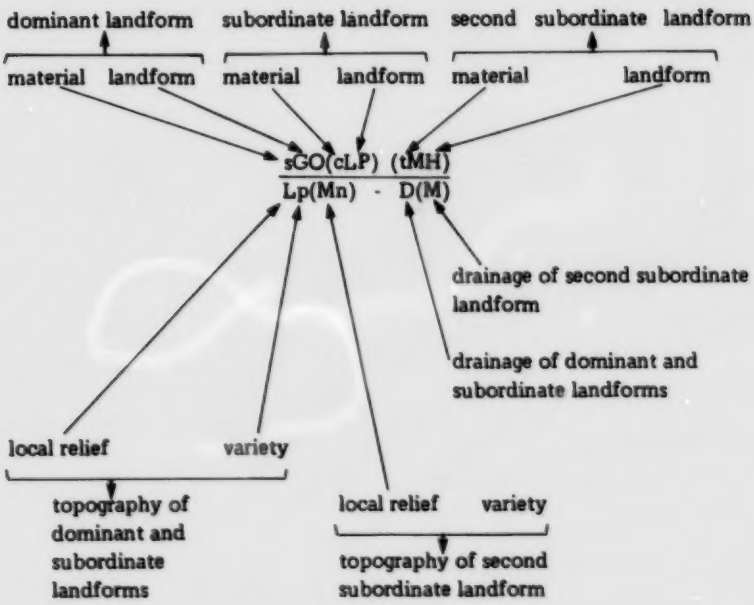
In complex areas, the dominant landform is shown first and the subordinate landform(s) appear in parentheses.

Example 1:



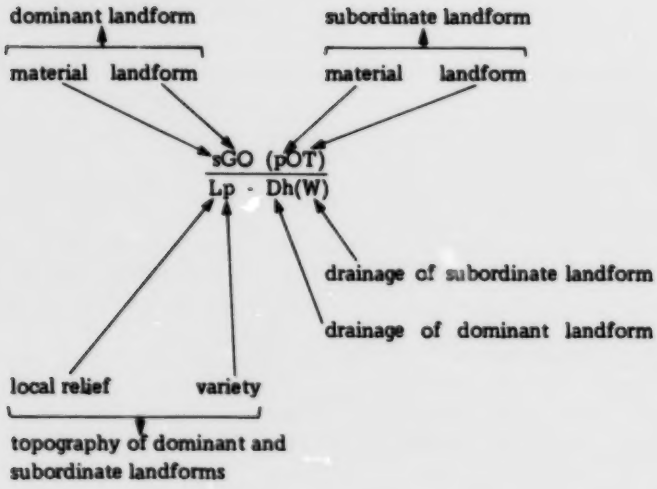
Note: The topography and drainage in parentheses refer to the landform shown in parentheses.

Example 2:



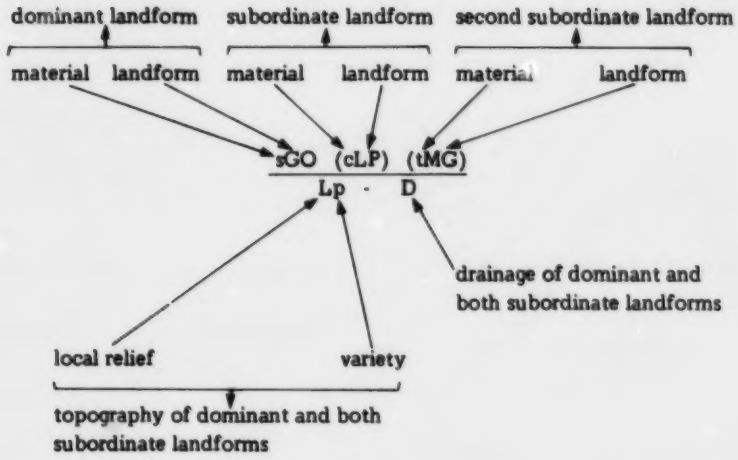
Note: The topography and/or drainage in parentheses refer to the second subordinate landform (in parentheses).

Example 3:



Note: If topography or drainage is similar in the dominant and subordinate landforms, then no topography or drainage symbol is shown in parentheses and the symbol shown applies to both landforms. If topography or drainage conditions are different in one of the landforms, a topography or drainage symbol is shown in parentheses to indicate this difference.

Example 4:



Note: Where topography and drainage conditions are similar in all of the landforms shown, no topography or drainage symbols are placed in parentheses.

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MAPS
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